U. S. FOREST SERVICE

RESEARCH NOTE NC-47

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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The Influence of Residual Stand Densities on Regeneration in Sugar Maple Stands

ABSTRACT.—Studies of regeneration 2, 5, and 10 years after cutting mature and overmature sugar maple stands to several residual densities show that (1) sugar maple is still the predominant species under all stand densities (2) nearly all regeneration reaching larger size classes became established before cutting (3) heavier cuttings (30, 50, and 70 square feet) are more rapidly making up deficits in sapling and pole sized classes than the lightest cutting (90 square feet).

Regeneration of sugar maple in northern hardwood stands in the Lake States is generally a simple matter (Eyre and Zillgitt 1953): Usually 15,000 to 30,000 seedling-size sugar maple per acre occupy the forest floor under mature uncut stands (U.S. Forest Serv. 1929), and many of them will develop after partial cutting. The number that develop and their rate of growth, however, can be influenced to meet the requirements of different forest management objectives by changing overstory densities. This Note describes seedling development under different degrees of overstory removal and briefly discusses the possible consequences for management.

In 1951 a stocking-level study was begun in Upper Michigan in mature northern stands that averaged about 80 percent sugar maple. Residual stand densities in trees 10 inches d.b.h. and over were 30, 50, 70, and 90 square feet of basal area per acre. Seedlings and saplings were measured under these overstories at 2-, 5-, and 10-year intervals on 1,000 quarter-milacre plots.

RESULTS

Five-year results reported by Church (1960) indicated that seedlings developed in about the same manner regardless of the overstory treatment. Ten years after cut, however, marked differences were apparent. Numbers of seedlings 6 to 35 inches tall decreased greatly under the lighter overstories, but increased slightly under 90 square feet. In contrast, the larger seedlings (36 inches tall to 0.5 inch d.b.h.) increased greatly in all densities except the 90-square-foot level (fig. 1).

About half of the smallest seedlings had appeared after cutting, but more than 99 percent of the larger seedlings were advance regeneration.[1] Trees up to 36 inches tall 10 years after cutting ranged from 5 to 35 years old and averaged about 12 years. Measurements of seedling internode lengths under overstories of 50 to 90 square feet showed that, on the average, seedlings grew more slowly under the denser overstory. However, under 90 square feet, removal of fewer trees resulted in fewer openings, less uniform overstories, and more variation in seedling growth than the heavier cuttings produced. Seedlings and saplings in openings in the 90-square-foot area apparently grew about as well as those in the less dense stands.

[1] *John H. Cooley; unpublished report on file at the North Central Forest Experiment Station, Marquette, Mich.*

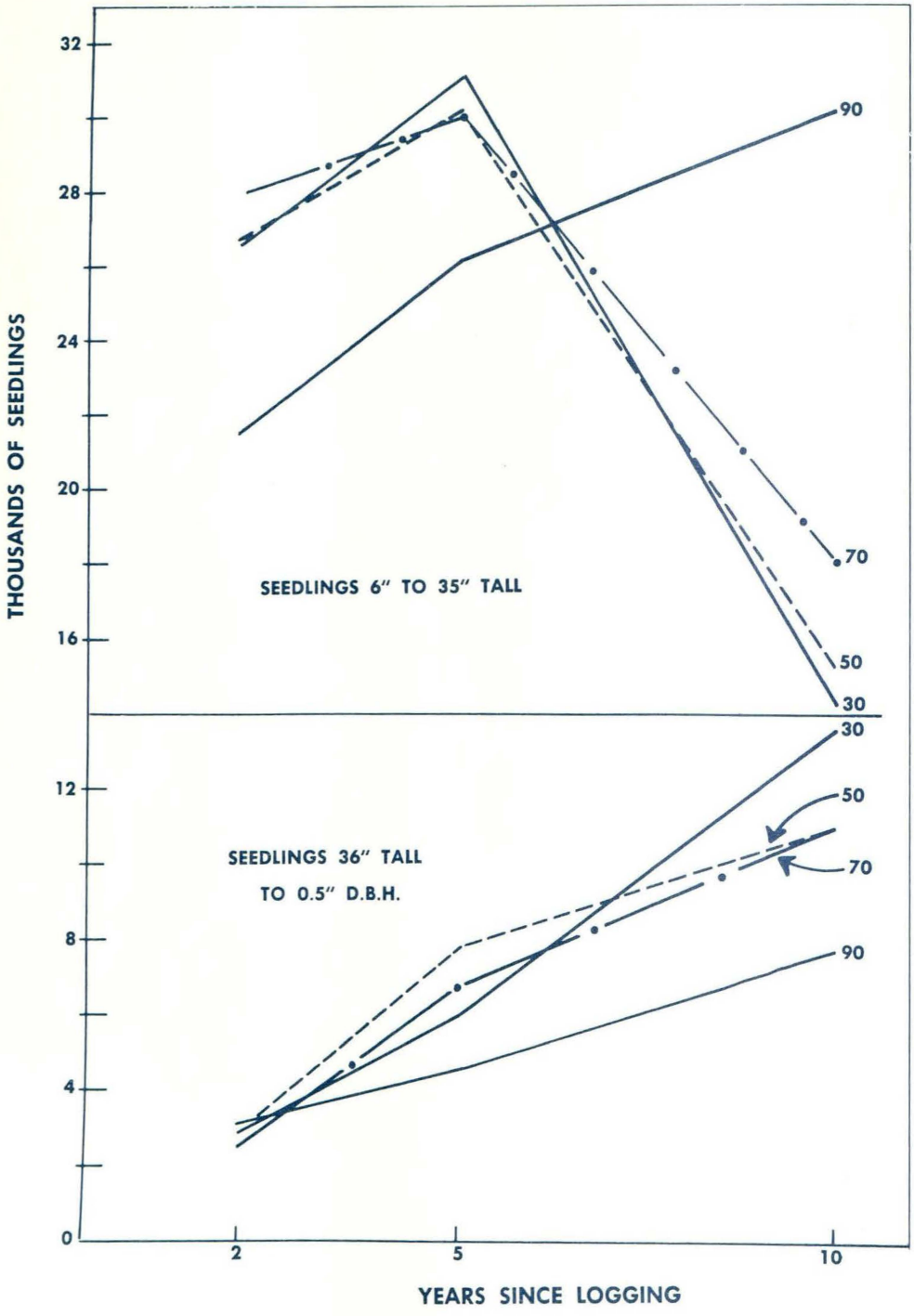

Figure 1.—Abundance of seedling reproduction under different levels of residual overstory (30, 50, 70, and 90 square feet of basal area)

Seedling development added to the next larger size class (table 1). In 10 years the number of 1-inch saplings per acre had increased from less than 100 in all stand densities to more than 1,000 in the 30- and 50-square-foot densities, more than 700 in the 70-square-foot density, and about 550 in the 90-square-foot density. The seedling growth stimulated by removal of the overstory had not greatly influenced other inch classes, but growth of the saplings added to the pole-size class (table 2).

Ten years after cutting, overstory density had only slightly influenced the number of quadrats stocked with species other than sugar maple. The lightest overstories (30 and 50 square feet) had 8 percent more quadrats stocked with yellow birch than the heaviest cutting had (90 square feet). Overstory density also had little effect on the total numbers of birch, and most of those are in the smallest size class. Sugar maple remains the predominant species, accounting for 90 percent of the seedlings and 75 percent of the saplings.

Table 1.—Summary of sapling-sized reproduction per acre 2, 5, and 10 years after logging, by tree size and residual stand density

DBH (inches)	Years since logging	Number of trees under a stand density (sq. ft. of basal area) of--			
		30	50	70	90
1	2	90	52	81	101
	5	160	103	186	179
	10	1,052	1,071	717	545
2	2	35	34	47	31
	5	55	44	55	39
	10	104	103	89	77
3	2	20	16	21	27
	5	35	30	34	27
	10	36	36	51	27
4	2	20	10	16	13
	5	10	12	14	16
	10	12	1	21	20

Table 2.—*Change in number of poles per acre by residual basal area*

Residual basal area (sq. ft.)	Number of poles: At time of cut	Number of poles: 10 years later	Number of saplings that grew to pole size	Number of poles that grew to sawtimber size
30	36	50	27	11
50	32	50	28	10
70	34	49	24	9
90	31	42	19	7

DISCUSSION

Many mature sugar maple stands are deficient in both sapling and pole-sized material. The study indicates that the three heaviest cuttings will make up the deficit soonest. However, regeneration reacted in much the same fashion under 30, 50, and 70 square feet of overstory; there is little reason for reducing the overstory below 70 square feet to provide more stems for future timber products. Furthermore, if present trends continue, the future promises an overabundance of poles in the heavier cuttings, possibly requiring repeated thinning of a low-value product.

The abundance of sugar maple and small number of relatively intolerant species such as yellow birch point to the difficulty in significantly changing composition solely by manipulating the overstory on sites that initially support large numbers of sugar maple. The slight additions of other valuable species such as yellow birch on the heaviest cuttings probably would not outweigh the anticipated loss in quality of the overstory sugar maple (Eyre and Zillgitt 1953), which is also a valuable species. The advanced age of the seedlings and their ability to respond to release illustrates sugar maple's aggressiveness and high tolerance rating and explains why other species do not become established after cutting.

Because the three heavier cuttings should initially provide more fast-growing seedlings, more succulent material will be available for browse; but rapid growth would reduce the time this material is available.

Esthetically, the 90-square-foot stand appears more parklike than any of the heavier cuttings, which have dense understories of up to 14,000 seedlings over 3 feet tall and 1,000 or more saplings per acre. Stands of 90 square feet, however, support about 6,000 seedlings and saplings per acre in patches that are sometimes extensive enough to destroy the parklike vista. Higher residual overstory basal areas probably will be necessary in any stand to be maintained for recreation use.

LITERATURE CITED

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